


Sustainability and Modern Society



ACE
ADULT CONTINUING EDUCATION AT UCC

Adult Continuing Education Seminar Series

Are Modern Society & Sustainability Compatible?

- ❖ Dr Edmond Byrne
Dept. of Process & Chemical Engineering, UCC
- ❖ Dr Ger Mullally
Dept. of Sociology, UCC

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Adult Continuing Education Seminar Series

UCC Context; an ongoing 'conversation':

- 'The Public Academy' by the School of Sociology & Philosophy, UCC: 'Communicating Climate Change' Dec. 2010
- Environmental Citizenship Workshop Sept. 2012
- Environment Planning & Sustainability Colloquium Series 2011-2012 (..& 2012-2013)
[Sch. of BEES, ERI, MPlan Planning & Sust. Dev., Sch. of Sociology & Philosophy]
- Environ. Citizenship/Sustainability Conference Sept. 2013
- Ongoing Green Campus Initiative, ERI, Buildings & Estates, etc.

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Are Modern Society and Sustainability Compatible?

- ❑ Overview & Historical Context
Ed Byrne
- ❑ Disciplinary and Trans-disciplinary Perspectives
Ger Mullally

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The Dilemma of Modern Society

Trainer (2012): *'The fundamental cause of the problems including the **destruction** of the **environment**, the **deprivation** and "underdevelopment" of the **Third World**, **resource depletion**, **conflict** and **war**, and the **breakdown** of **social cohesion**' is*


over-production and over-consumption.

But what drives this '**centralized throw-away mass production model**'? (Arai et al., 2009)

Is this consumption driven model a manifestation of the **Modern** paradigm, a **reductionist** paradigm honed over the past four centuries, and based on a **Cartesian** world-view?

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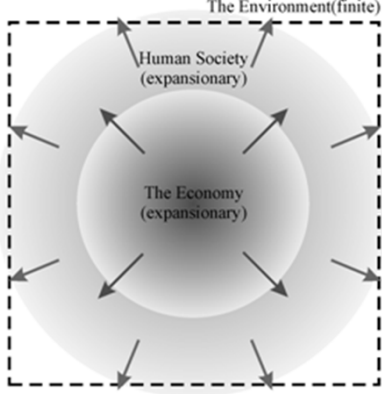
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The Dominant Reductionist Modern Paradigm


The Reductionist Modern paradigm - the Dominant Social Paradigm, seeks ongoing **growth** in material and energy appropriation.

However, this is not compatible with a sustainable society operating within **finite global limits**.



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The Dominant Reductionist Modern Paradigm

As well as seeking growth the Modern paradigm seeks:

- system '**optimisation**' through a quest for ever greater **efficiency** and
- to '**objectively**' extinguishing **risk** and **uncertainty** through
- ultimate system **control**


However, in practice it actually suppresses necessary system traits as:

- **Redundancy** **Resilience** **Flexibility**
- **Freedom** **Context** **Creativity**

The result is far from optimal; instead it yields **rigid, vulnerable** and **unsustainable** systems, ultimately destined for **collapse**.

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The Dominant Reductionist Modern Paradigm

...is essentially a paradigm of **Simplicity**.
 It's myths include concepts around:


'bigger is better' 'market efficiencies' 'economies of scale'

'survival of the fittest' 'elimination of risk'

as self-evident whole truths.

It considers that reality can be characterised, and ultimately mastered through the construction of necessarily **simplified reductionist discipline-specific algorithmic models**.

The inherent shortcomings of such models are rarely recognised, either explicitly or implicitly, in terms of the inherent inability of replica models to either capture or predict **complex** reality.

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An Alternative Paradigm?

An alternative paradigm, one which both recognises and embraces **complexity**, is a necessary requisite for realizing **sustainability** across all domains, including the social, ecological and techno-economic.

Reductionism;
 seeking:

- 'optimisation' through efficiency,
- 'objective reality',
- to extinguish risk and uncertainty through system control.



Complex thinking;
 seeking:

- resilience, redundancy,
- flexibility, freedom,
- context, creativity
- to embrace uncertainty and gain contingent system understanding, recognising experiential knowledge.

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Features of competing paradigms in production/consumption domains

• Increased productivity	→	• Increased quality
• No time wasted on non quantifiable (non productive) tasks. Work as means to end.	→	• Time to think, reflect, develop new insights, be creative and gain satisfaction. Enjoy work!
• Economies of scale and globalisation	→	• Localisation and community involvement
• Profits and wealth concentrated	→	• Profits and wealth distributed
• Local unemployment	→	• Local employment
• Fewer people work longer and more flexible hours	→	• More people work fewer and more sociable hours
• Global supply chains	→	• Local community networks
• Reduced redundancy, increased fragility	→	• Redundancy and greater resilience, robustness
• Cheaper goods ..greater consumption	→	• More expensive goods ..reduced consumption
• Intensification	→	• Diversification
• Specialisation (division of labour)	→	• Artisan
• Recycle	→	• Avoid/Reduce
• Economic development	→	• Social, ecological and economic sustainability
• Quantifiable economic wealth and growth over social and ecological aspects	→	• Qualitative social, ecological and economic flourishing
• Uniformity	→	• Context

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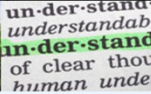
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Modern Society: ..tallied with idea of ongoing progress/development through growth, efficiency and suppression of risk


21st Century Rebalancing? .. constrained by ecological/resource limits, recognises vulnerability and need for resilience via sufficiency and innovation

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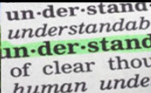
A manifestation of the modern paradigm: Efficiency..

- ...is a **ratio** of **output over input**
- 19th C Engineering basis; Rankine's thermodynamic efficiency (2nd Law of Thermodynamics: 100% efficiency is impossible)
- A **dominant principle of modern society**
 - not just engineering but economics, management, etc.
- Used for **quantification**, measurement and comparison
- Has come to be equated with **productivity, usefulness, progress, goodness**
- But, does not recognise absolute **limits**, since it is a ratio
- Nor is it **useful/desirable** for many important **social** and **ecological** activities; e.g. inspiration, creativity, innovation, flourishing, care, love, natural and biological systems (e.g. ecosystems, evolution, brain, kidneys), gastronomy, spirituality, etc.



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Development of principle of efficiency..

Neoclassical Economics

- 'Age of Efficiency' (ca. 1890-1930)
- **Homo economicus** (the **rational** economic human)
- **Prosperity** equates with (the economically **quantitative** measures of) **personal gain** (e.g. GDP per head) and **efficiency** (e.g. productivity) rather than (qualitative) entities such as social meaning, happiness and sustainability

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~~Modern Reductionist Paradigm:
Higher Efficiency = Lower Consumption *~~
(*all else being equal)

But..

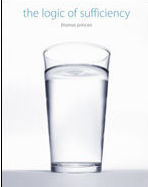
In complex adaptive systems, 'all else' is never equal!!

William Stanley Jevons:
Higher Efficiency leads to **Increased Consumption**




...doing even more with more – the 'cake' simply gets bigger due to lower costs e.g. rail/air travel, lighting, suburban sprawl, etc.

Feeds growth in outputs, economic growth and increased consumption



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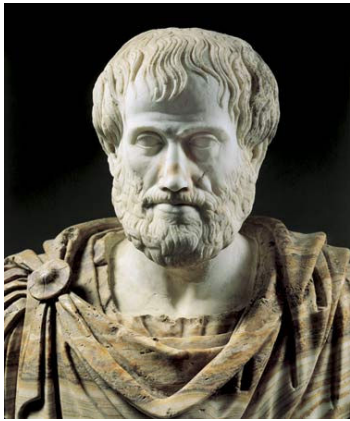
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Historical Background to Modern Science

'**Natural philosophy**' incorporated both philosophy and science from ancient Greek times until the 17th Century.

Thereafter there was a cleavage between philosophy/the humanities and what became known as '**natural science**'.



Aristotle (384-322 BC) 'father of science'

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Renaissance

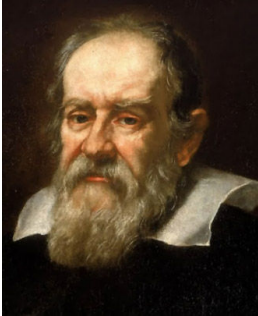
..great flourishing of the arts, philosophy, science and engineering.




Leonardo da Vinci (1492-1519)
and his drawings of toothed gears








Galileo (1564-1642) suggested that he could conceive **natural, mechanical explanations** for all **natural phenomena** except perhaps for the tides.


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Early Modern times


René Descartes (1596-1650) pioneered '**rationalism**': i.e. **reason alone** was the way to '**truth**' and **reality**. Input from the **senses** and **intuition** are unimportant here.

*"Deal only with ideas that are **distinct, precise, beyond any reasonable doubt**; therefore rely on **geometry, mathematics, quantification, measurement** and **exact observations**."*




Descartes also proposed the idea of '**dualism**'; humans consist of two components; a physical/mechanical body and a non-material mind or soul ('res cogitans') which allows for free will.

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Historical context; Early modern times




'It is possible to reach a kind of knowledge which will be of the utmost use to men ..and thereby make ourselves the lords and possessors of nature'.

Rene Descartes (1638)

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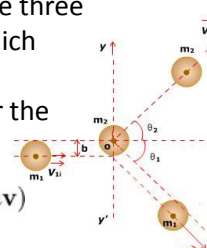
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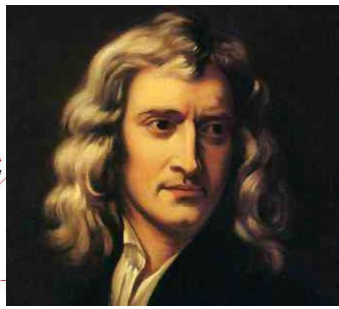


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Early Modern times

Issac Newton (1642-1726) developed infinitesimal calculus and the three universal laws of motion which enabled many scientific and technological advances over the following centuries.



$$\mathbf{F} = \frac{d}{dt}(m\mathbf{v})$$



$$m_1\mathbf{v}_1 + m_2\mathbf{v}_2 = m_1\mathbf{v}_1 + m_2\mathbf{v}_2$$

The success of scientists in **describing the physical world** by reducing it to **mathematical formulae** which approximated reality helped shape the increasingly commonly held view that all of nature could eventually be described scientifically and that there are **no inherently unknowable facts**.

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Historical context; Modernity

German philosopher, scientist and literature giant **Johann Wolfgang von Goethe (1749-1842)** held a broader conception of science:



*“science is as much an inner path of **spiritual development** as it is a discipline aimed at **accumulating knowledge of the physical world**. It involves ..faculties such as **feeling, imagination** and **intuition**.”*


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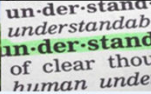
Modernity and ‘The Two Cultures’

Since the **mid 1600’s**, **rational science** and **relational humanities** have carried different concepts of reality, each often distrustful of the other.

In 1965 Cambridge physicist **C.P. Snow** famously identified (and bemoaned) this break in **‘The two cultures’**.




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Historical context; Modernity


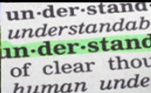
Newtonian physics has proved **hugely successful** and provided a basis for the formation of the modern world; from the onset of the industrial revolution and further scientific advances through the 19th and 20th right through sending **people** to the **moon** in **1969** and beyond.

This influence was so great, that most people with a basic notion of science still implicitly equate “scientific thinking” with “Newtonian thinking”.
(Heylighen et al, 2007)




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Certainty and Objectivity in the 20th Century

The German mathematician **David Hilbert** exclaimed in 1900 that just **23 problems** in the **Newtonian system** were outstanding, and once these had been solved our knowledge of the universe would be complete!



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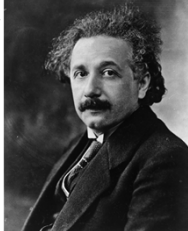

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Problems with Certainty & Objectivity in 20thC:1

However, limitations of Newtonian physics were quickly exposed.


Albert Einstein's 1915 theory of general relativity demonstrated that 'objectivity' was relative; reality depended on the observer.

Werner Heisenberg's theory of uncertainty (1927) added another blow and also required the presence of an **observer**.
(It is **theoretically** and **physically impossible** to determine both the **position** and **momentum** of an electron **simultaneously with certainty**.)

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Problems with Certainty & Objectivity in 20thC:2


Einstein tended to agree with von Goethe a century earlier:
*"the **intuitive** mind is a sacred gift, and the **rational** mind is a faithful servant. We have created a society in which we honor the **servant** and have forgotten the **gift**,"*

Nor did he support Descartes' faith in pure reason:
*"Pure **logical** thinking can give us no knowledge whatsoever of the world of **experience**; all knowledge about reality begins with experience and terminates in it."*




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Problems with Certainty & Objectivity in 20thC:3


Mathematician **Kurt Gödel's** attempt to solve one of David Hilbert's 23 problems of logic (the '**Entscheidungsproblem**') literally turned logic on its head.



Albert Einstein & Kurt Gödel

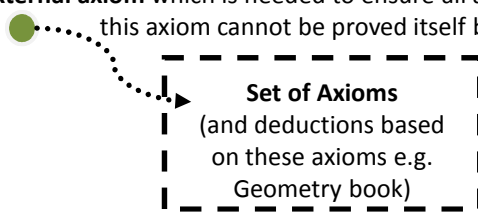
This led to Gödel's **incompleteness theorem** (1931), which instead of solving the problem actually **destroyed** the underlying basis of the **self-contained logic of logic**; it must be based on *some* starting assumption.

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Problems with Certainty & Objectivity in 20thC:3

External axiom which is needed to ensure all axioms in system set are proven;
 this axiom cannot be proved itself but must be assumed



Representation of Gödel's Incompleteness Theorem

Gödel's findings were profound. They showed that **even in pure mathematics that there is no fully closed system**; there is always something outside which is an unknown. '**Unknowingness**' or **uncertainty is inherent to every system** therefore; **Truth is not based on logic and reason alone.**

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Problems with Certainty & Objectivity in 20thC:3

The discovery of '**unknown unknowns**' or the '**unknowable**' as a **reality**, has even called into question the possibility of the existence of a 'theory of everything'.



Cosmologist **Stephen Hawking** suggested (2002):

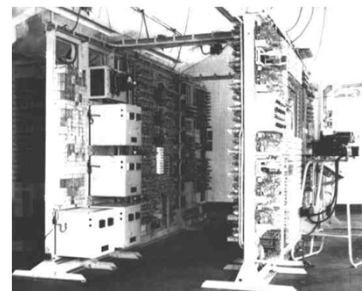
"Some people will be very disappointed if there is not an ultimate theory, that can be formulated as a finite number of principles. I used to belong to that camp, but I have changed my mind."




Problems with Certainty & Objectivity in 20thC:3



British mathematician and wartime code breaker **Alan Turing** published a seminal 1937 paper, which both confirmed Gödel's theorem and envisaged a 'Turing machine' – or computer.





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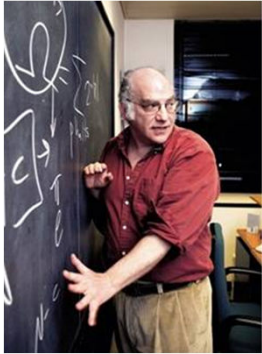
Problems with Certainty & Objectivity in 20thC:3

Gödel's and Turing's work has since been built on extensively by mathematicians such as **Gregory Chaitin**, who has concluded that ultimately **all mathematics is the result of individual/cultural bias and human limitation**.


Similarly this work has stimulated the field of Artificial Intelligence (AI). Turing believed the human mind was a machine and could be thus replicated by a computer.

However **emotion, intuition** and **consciousness** are elusive concepts.

'The human mind is not algorithmic.'
(Kauffman, 2008)





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Problems with Certainty & Objectivity in 20thC:4

Complexity theory emerged from **chaos theory**, which developed from meteorologist **Edward Lorenz's 1963** paper on the **'butterfly effect'**, building on **Henri Poincaré's** earlier work (1908).

But while **chaos** can result from simple **deterministic** rules, **complexity** relates to a broader set of systems which **cannot be described by deterministic models**.

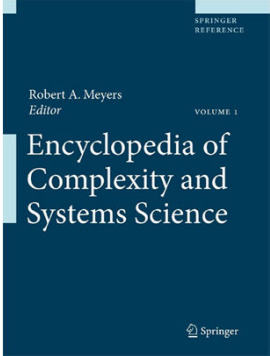
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Problems with Certainty & Objectivity in 20thC:4


Complex systems can never be fully predicted or controlled, but offer the potential for **emergence, serendipitous creativity** and **evolution**, thus recognising Gödel's inherent factor of 'unknowing'.

Complexity theory thus offers the tantalising prospect of **reuniting 'the two cultures'** through recognising the reality of **creativity, emergence** and **values** as well as the **logic** and **rationalism** of **modern science**.



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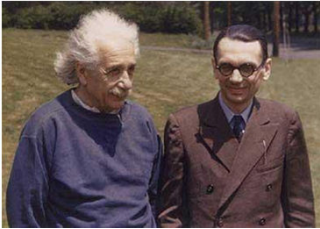
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Problems with Certainty & Objectivity in 20thC

Cartesian/Newtonian science shown to be only a **partial representation** of scientific reality in the 20th Century..

- **1) Einstein's** Theory of Relativity (1916)
- **2) Heisenberg's** Uncertainty Principle (1927)
- **3) Gödel's** Incompleteness Theorem (1931)
- **4) Poincaré's** work (1908) & **Lorenz's** Chaos Theory (1963), followed by **Complexity Theory**



20th Century scientific discovery has shown that ;

- Science is **not** a journey towards some universal **objective truth**.
Indeed 'truth' can only derive from shared agreement about meaning rather than through some 'objective reality'.
- Many real systems are complex, whose behaviour cannot be deterministically predicted or understood through **rationality** alone.

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Reductionist Modern Paradigm: Blind to Complexity

*'The **modern** pathology of mind is in the **hypersimplification** that makes us blind to the **complexity** of reality. This blindness is part of our **barbarism**. Only **complex thought** will allow us to civilize our knowledge.'*
(Edgar Morin, 2008)




*'The **big messes** are all a result of our failures to recognize **complexity** and act accordingly'*
(John Ehrenfeld, 2012)



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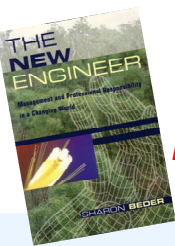
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The Real World: Uncertainty a Constant Companion

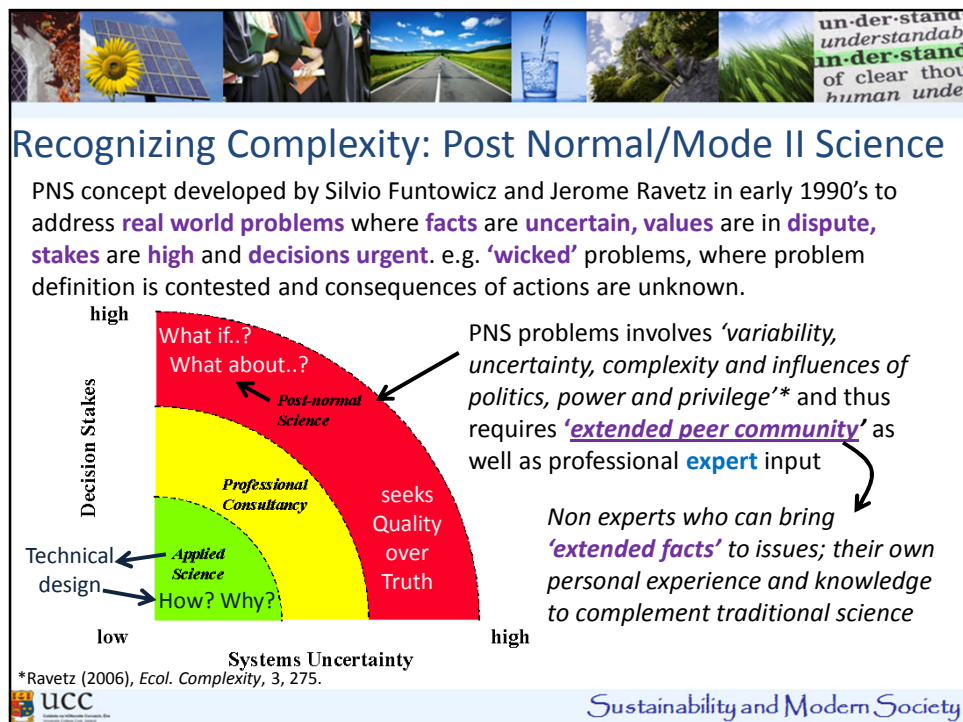
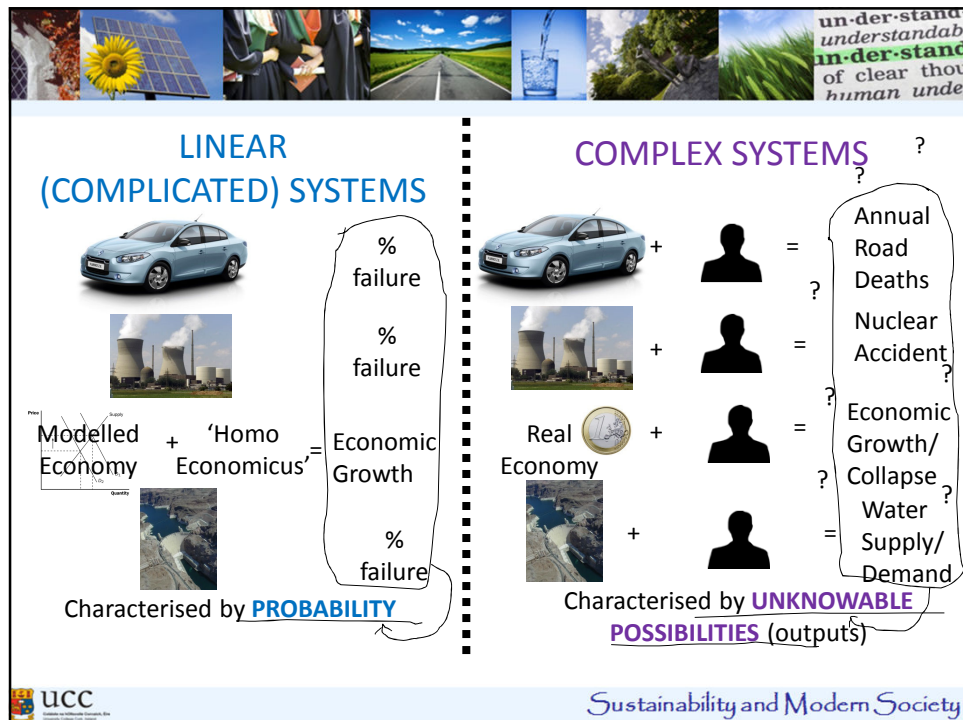
Traditional engineer/scientist (adept at solving in the) Linear realm:
Closed quantifiable systems, all possible outcomes known which can be **identified** and **predicted** or assigned probabilities.
e.g. **machine** operations


Complex realm:
Open systems with **infinite unknown possibilities** to which probabilities cannot be assigned ('unknown unknowns'), enables **creativity, evolution, inherent uncertainty** and **risk, context, agency, values, emergence, self organisation**, e.g. **human** activity and agency, wicked problems
Requires 'new engineer'/scientist

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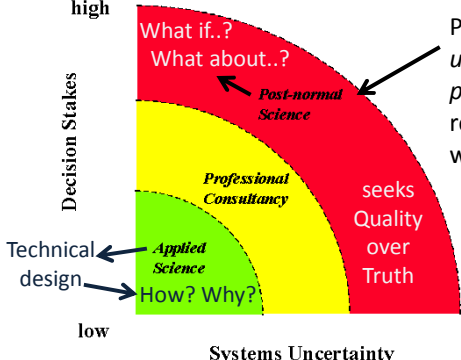
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Recognizing Complexity: Post Normal/Mode II Science

PNS concept developed by Silvio Funtowicz and Jerome Ravetz in early 1990's to address **real world problems** where **facts** are **uncertain**, **values** are in **dispute**, **stakes** are **high** and **decisions urgent**. e.g. '**wicked**' problems, where problem definition is contested and consequences of actions are unknown.




PNS problems involves '*variability, uncertainty, complexity and influences of politics, power and privilege*'* and thus requires '*extended peer community*' as well as professional **expert** input

"In general, the **real world** has so much *variability and uncertainty*, that it will be the more coarse, **rough-and-ready** aspects of the *scientific evidence* that are **relevant**." Ravetz (2006)

*Ravetz (2006), *Ecol. Complexity*, 3, 275.

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Recognizing Complexity: Post Normal/Mode II Science

"We are now witnessing the emergence of a **new approach to problem solving** strategies in which the role of science, still essential, is now appreciated in its full **context** of the **uncertainties** of **natural systems** and the relevance of **human values**."

Jerome Ravetz (1999)

'What we want to draw out, beyond reductionism and holism, is the idea of the **complex unity**, that links **analytical-reductionist** thinking and **global thinking** ..This means that if reduction will remain an essential characteristic of the scientific mind, it is no longer the only, nor, particularly, the last, word.'

Edgar Morin (*On Complexity*, 2008)

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Normal Science and Mutual Misunderstandings

Scientists and engineers often presume that if the **public** had **more technical knowledge** of **science**, they would come around to **accepting** various **projects** and initiatives that arouse public **opposition**.

However, this is generally erroneous – the public is more concerned with:

- **Ethics/values**
- **Policies**
- **Risk**
- **Safety**


*don't **frack** with **Leitrim*** 



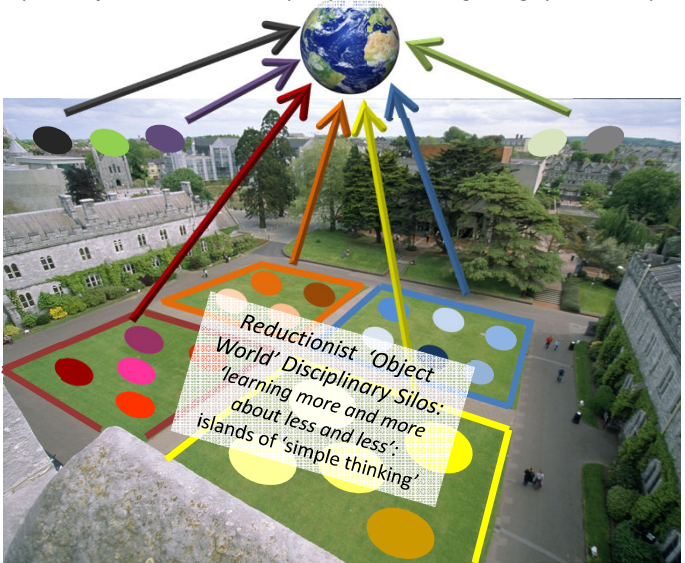
Since science and engineering is **not capable of giving 'objective', absolute or definitive answers** to these **normative** and **value laden issues** (which lie outside the realm of Mode I/Normal/Reductionist science)

Such **misunderstandings** have often led to mutual **misconceptions** and **distrust** - and a poor public image of science and engineering.


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Develop multi-faceted multi-scale perspectives, recognising system complexity



Reductionist 'Object World' Disciplinary Silos:
 'learning more and more about less and less';
 islands of 'simple thinking'

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Are Modern Society and Sustainability Compatible?

- ☐ Overview & Historical Context
Ed Byrne
- ☐ **Disciplinary and Emergent
Trans-disciplinary Perspectives**
Ger Mullally

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Some Disciplinary Considerations

- By 2008, “environmental sociology” had become a well-established and well-recognized field of sociology, but exactly 30 years earlier, in 1978, it was essentially non-existent. That was the year that saw the publication of the first two articles that, along with later work by Riley Dunlap and William Catton, began to make possible the subsequent development of the field (Friedenburg 2008: 449).
 - At the base of their project was a call for the explicitly ‘ecological’ perspective in sociology - A New Ecological Paradigm (boundary work)
 - 1980s US/UK Sociological Associations saw renewed calls for Environmental Sociology in hostile socio-political environments
 - 1990s Sustainability and the Social Sciences
 - 1995 – Sociology as if Nature Mattered (Murphy)
 - 2000s Climate Change and Sociology
 - 2008 – Global Warming and Sociology – Multi-disciplinarity: Sociology as the handmaiden of climate science (Lever-Tracey)
 - 2009 – Sociological Perspectives on Climate Change (Nagle, Dietz and Broadbent)
 - 2012 Renewed Call for Eco-sociology (Stevens)
 - Convergence of different research programmes bringing emergent socio-ecological theories into view

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- 'As a graduate student in a leading department in the mid to late 1970s, I was able to work on "environmental" topics, but that was mainly because I found three faculty mentors who tolerated and even encouraged my interests ... I was also helped by the fact that I was able to venture outside of sociology, working with political scientists, engineers, psychologists, and an assortment of open-minded biophysical scientists. Within sociology, however, I heard a number of distinguished, internationally respected figures saying almost exactly the same thing: All of this "environmental *stuff*," as they often called it—with the emphasis conveying something akin to disgust—was something that they considered to be a passing fad' (Friedenburg 2008)
- Rejection of 'determinism' in mainstream sociology (Durkheim) and a rejection of Huntington's 'ecological determinism' and a shift within Human Ecology that was concerned with societal growth, advancement and improvement and openly hostile to any 'limits to growth'.

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- A comprehensive and accessible survey of the traditions, paradigms and intellectual currents is synthesised and theorised in Strydom's *Risk, Environment and Society* (2002).
- In the conclusion on the 'Public Role of Sociology' Strydom notes a shift the 1970s and 1980s where strong pressures came on sociologists to re-define their self understanding as intellectuals dealing with society in its complexity to experts serving policy- and decision-makers ...to become politically useful (writing today this would narrow even further to economically useful – See for example Baumann 2010)
- Understandings of political usefulness are open to questioning through a range of developments: an increase in the complexity of society, the pluralization of relations, the transformation of the public sphere due to new social movements, the shift of social scientific focus from stable, causal and linear relations to complex non-linear ones occurring over time and depending on cultural structures.

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- Sociology cannot restrict its usefulness of its knowledge to political and economic elites and decision-makers, but is required to communicate it also to those subject to decision-making processes and decisions (ibid.)
- 'the public significance of sociological knowledge does not inhere in sociology as such. Forming part of a relational complex in a structured social setting, its significance must be sought in the relation of sociological knowledge to other knowledge(s) in the context of public communication and discourse. Sociological knowledge does not exist beyond society, but is constructed and takes on form only through the discursive interrelation of the different types of cognitive structures and knowledge(s) carried by a plurality of participants. Under these conditions, the public role of sociology commences with the making visible of the whole spectrum of different experiences, perceptions frames and knowledge. This is achieved by locating and heightening the tensions and relating the intersecting lines of creativity and conflict to each other' (Strydom2002: 158).

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An Emergent 'Family' of Socio-ecological theories

- In the **socio-metabolic transitions** approach ...a time frame from decades to centuries and global interconnectedness are considered. At this scale one cannot easily deal with actors and their deliberate effort ...one can mainly analyse structural change of interlinked social and natural systems across a broad range of variables.
- Macro or 'landscape' level focus as a dynamic equilibrium of a system of society-nature interaction. When a regime changes, so too does not only the society and its metabolism, but also the natural systems it interacts.
- Intentional changes induced by society (change in land use) and unintended consequences (pollution) can modify natural systems
- In co-evolutionary processes, ideal type states can remain more or less in dynamic equilibrium over long periods but there are also periods of transition (Fischer-Kowalski and Rotmans 2009)

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- The evolution of coupled socio-ecological systems can be characterized by a sequence of relatively stable configurations, here denoted as 'socio-metabolic regimes', and comparatively rapid transitions between such regimes. We discern three fundamentally different socio-metabolic regimes: hunter-gatherers, agrarian societies and industrial society ...industrial society is at least as different from a future sustainable society as it is from the agrarian regime. The challenge of sustainability is, therefore, a fundamental re-orientation of society and the economy, not the implementation of some technical fixes (Haberl et al 2011: 1).
- On the global level today, about two-thirds of the world's population live more or less by a metabolic profile of the agrarian societies in the past, and they are rapidly about to change that toward an industrial profile (Fischer-Kowalski and Rotmans 2009).
- Analytic programme with theoretical implications ...

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- Dutch **Transitions Management Approach** - A complex systems approach for governing transitions
- Multi-level approach Landscape, Regime and Niche
- The Dutch approach describes the dynamics of a transition in terms of generic "patterns" resulting from a complex interplay between a dominant (or "incumbent") regime and a set of competing niches. The dynamics involve tensions between the regime and its environment (both from the landscape and niches) out of which threats may arise to the currently dominant regime. The regime may be threatened from the niche level, or from changes at the broader landscape level of economic, ecological, and cultural trends, or from internal misalignment among regime actors.
- Focused on complex adaptive systems which co-evolve with their environments, have emergent properties (the spontaneous formation of new structures and patterns from within) and are capable of self-organisation – constantly producing variety and novelty which can be selected and stabilized as a regime.

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- Not a command and control approach – emphasises experimentation, social learning, and guided change
- Focused on functional socio-technical systems e.g. Energy, Transport etc. not place or geographically embedded systems
 - E.g. ‘societal functions are fulfilled by one or more socio-technical systems – housing, feeding, production, provision of energy etc’ (Marletto 2012)
- Addresses policy and politics but also societal mobilisation for sustainability
 - There is an explicit recognition of power and politics
- Seeks to overcome path-dependence and ‘lock-in’, focus on path creation and eliminating negative resilience in systems.




- The unit of analysis in social-ecological research is a **social-ecological system**. This moves over time through a trajectory of states conditioned by various endogenous and exogenous processes, including technologies.
- A social-ecological system is typically rooted in a particular spatial context such as a watershed, a rangeland, a forest, or a region (also river basin management or ICZM). Here, resilience is the ability to maintain system structure and function in the light of both shocks and stresses in this wider environment
- The focus is on a particular setting in which material resources, ecological configurations, and environmental services may be implicated in, and affected by, the development and operation of a number of technological regimes.



- Discussions of adaptive governance have generally focused on the experimental ways that flexible collective capabilities can be built up in actor networks that maintain or enhance the resilience of social-ecological systems...however, socio-ecological systems in an undesirable state will require governance for transformability where undesirable is a social-ecological state deemed no longer to be delivering key services for groups dependent upon the system (Smith and Sterling 2010).
 - (In the governance for sustainability literature the idea of cooperative management regimes is used).

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Third Level and Trans-disciplinary Processes

- ...unsustainability is nothing but the result of multiple societal lock-ins in high carbon systems, and environmental policies take the form of intentional actions aimed at triggering systemic change and making the creation of low carbon systems viable (Marletto 2012: 48).
- ...**trans-disciplinary** processes and research can induce an efficient utilization of the knowledge systems available in society to generate socially robust knowledge, orientations and problem transformations...which is a key element of societal capacity building (Scholz 2010: 67) .
- '...knowledge integration of different types of epistemics (e.g. scientific and experiential), utilizing and relating disciplinary knowledge from the social, natural and engineering sciences (Scholz 2010: 71).
- Most definitions conclude that trans-disciplinarity goes beyond science and deals with relevant, complex, societal problems and organizes processes that relate knowledge and values of agents from the scientific and non-scientific world (Scholz 2010: 73).

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'Multifarious Complexity .. (Dreissen, Leroy and van Veirssen 2010)

- *From Climate Change to Social Change: Not Just a Better Science Policy Interface*
 - *Epistemological and Cognitive Complexity*
 - From a natural science perspective the complexity of the climate system which has to be viewed from multiple disciplinary angles with different methods and involves scientific uncertainty –coupled with the uncertainty of societal reactions and response
 - *Social and Political Complexity*
 - Social-epistemological distance – e.g. litter and noise are immediate and can be perceived directly by the senses, complex problems have to be mediated and explained, social and political mobilization have to foster some level of social trust
 - *Managerial complexity*
 - Despite efforts at building and institutional infrastructure for the governance of the climate issue there is still a large fragmented array of actors and strategies

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...and other challenges


- The assumption is that engaging societal actors will enhance the legitimacy and quality of knowledge ...but does society want to be involved? Is there a societal knowledge demand?
- The role of economic interests – there are market implications (winners and losers). What are the conflicting knowledge interests?
- Questions of politics and ethics?

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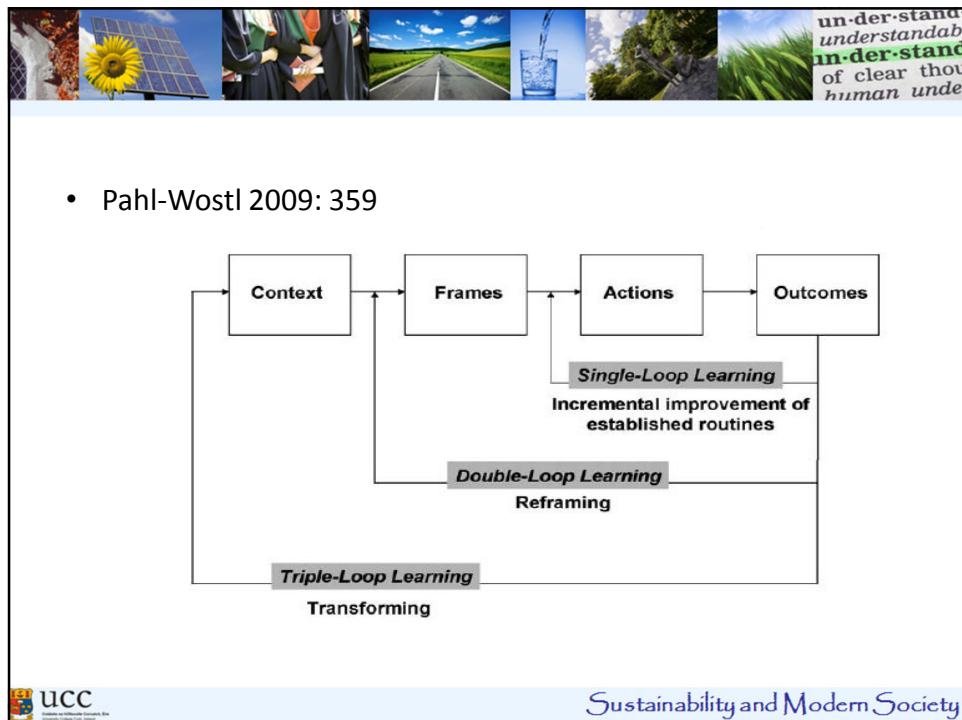
- Education for Sustainability above all means the creation of space for **social learning**. Such space includes: space for alternative paths, space for new ways of thinking, valuing and doing, space for participation minimally distorted by power relations, space for pluralism, diversity and minority perspectives, space for deep consensus and respectful disagreement, and differences, space for autonomous and deviant thinking, space for self-determination, and finally, space for contextual difference (Corcoran and Wals 2004: 224).

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- 'To escape lock-in, actors need to recognize how their frame of reference influences and constrains their thinking and other legitimate frames of reference exist' (Pahl-Wostl 2010 136).
- She outlines a model for social learning based on other disciplinary developments
 - Single Loop Learning
 - Single loop – choose among a set of actions within (existing) assumptions , incremental change not calling established routines into question
 - Double Loop Learning
 - – revisit assumptions (e.g. about cause effect-relations) within a value-normative framework. What is full space of reframing within structural constraints. Goals ,problem framing and achieving goals
 - Triple Loop Learning
 - – reconsider underlying values and beliefs, world views, assumptions within a world view that do not hold anymore (2010 139).

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- Adapting Pahl-Wostl to a third level context this involves recognition that our paradigms and structural constraints impede reframing, and looking beyond to the identification/extension/ initiation of new networks, and consideration of new boundaries and structures.
 - The current seminar series hopes to contribute to this learning process, building on and linked to, many other related processes.
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SEMINAR SERIES PROGRAMME

1. *Are Modern Society and Sustainability compatible?*
E. Byrne, G. Mullally 2 October
2. *An Unsustainable Societal Construct*
D. Chapman, J. Fitzpatrick 9 October
3. *Philosophy & Art*
G. Parkes, C. Fitzgerald 16 October
4. *Science, Complexity & Spirituality*
G. Mullally, E. Byrne, D. Gabuzda 23 October
5. *Planning and Law around Sustainable Development*
W. Brady, B. Sage-Fuller 30 October
6. *Economics & Politics*
J. Barry, S. O'Tuama N.B.: *Monday*, 5 November
7. *Moving to a Sustainable Societal Construct*
J. Fitzpatrick, D. Chapman 13 November
8. *Bringing it all together; A transdisciplinary endeavor*
A selection of lecturers from above. 20 November

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